

Southwest Regional Partnership on Carbon Sequestration

Southwest Phase II Overview

DE- FC26-05NT42591

May 11, 2006

Alexandria, Virginia

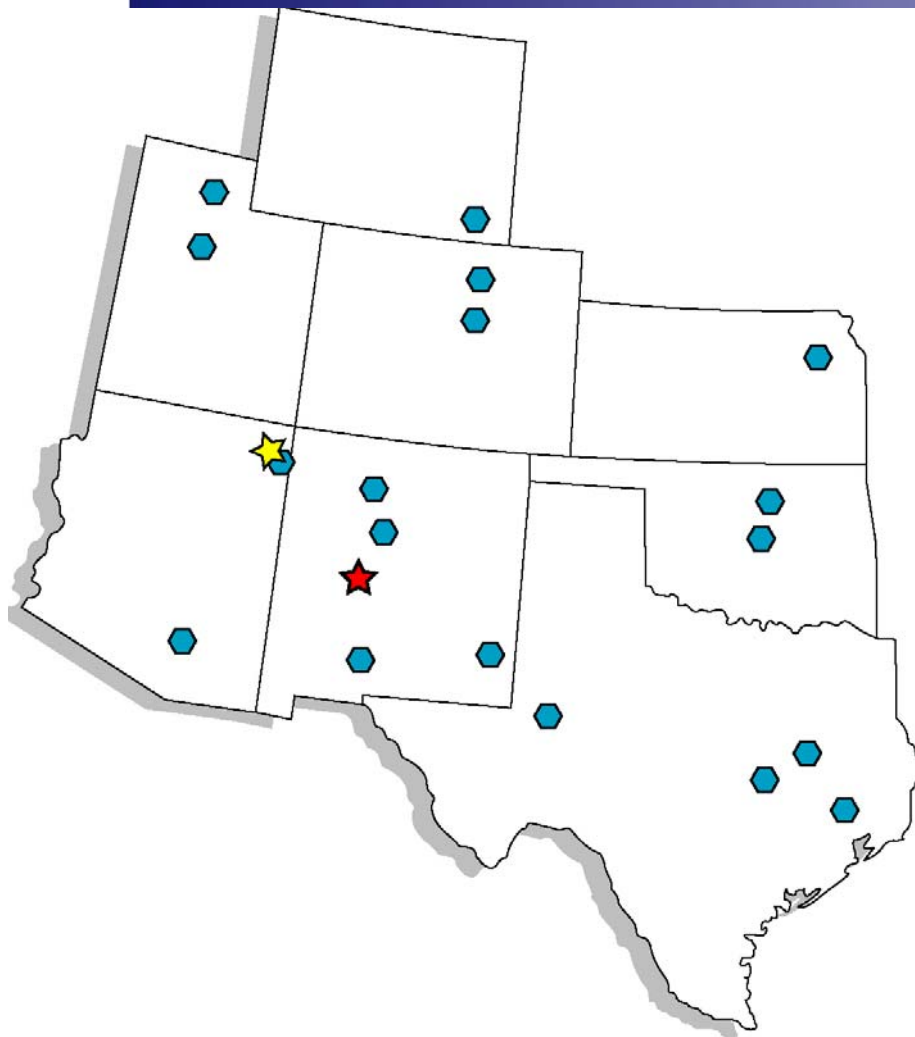


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Partners



Southwest Regional Partnership
on Carbon Sequestration

Acknowledgments:

- U.S. Department of Energy
- NETL

Partners - in all partner states:

- major universities
- geologic survey
- other state agencies

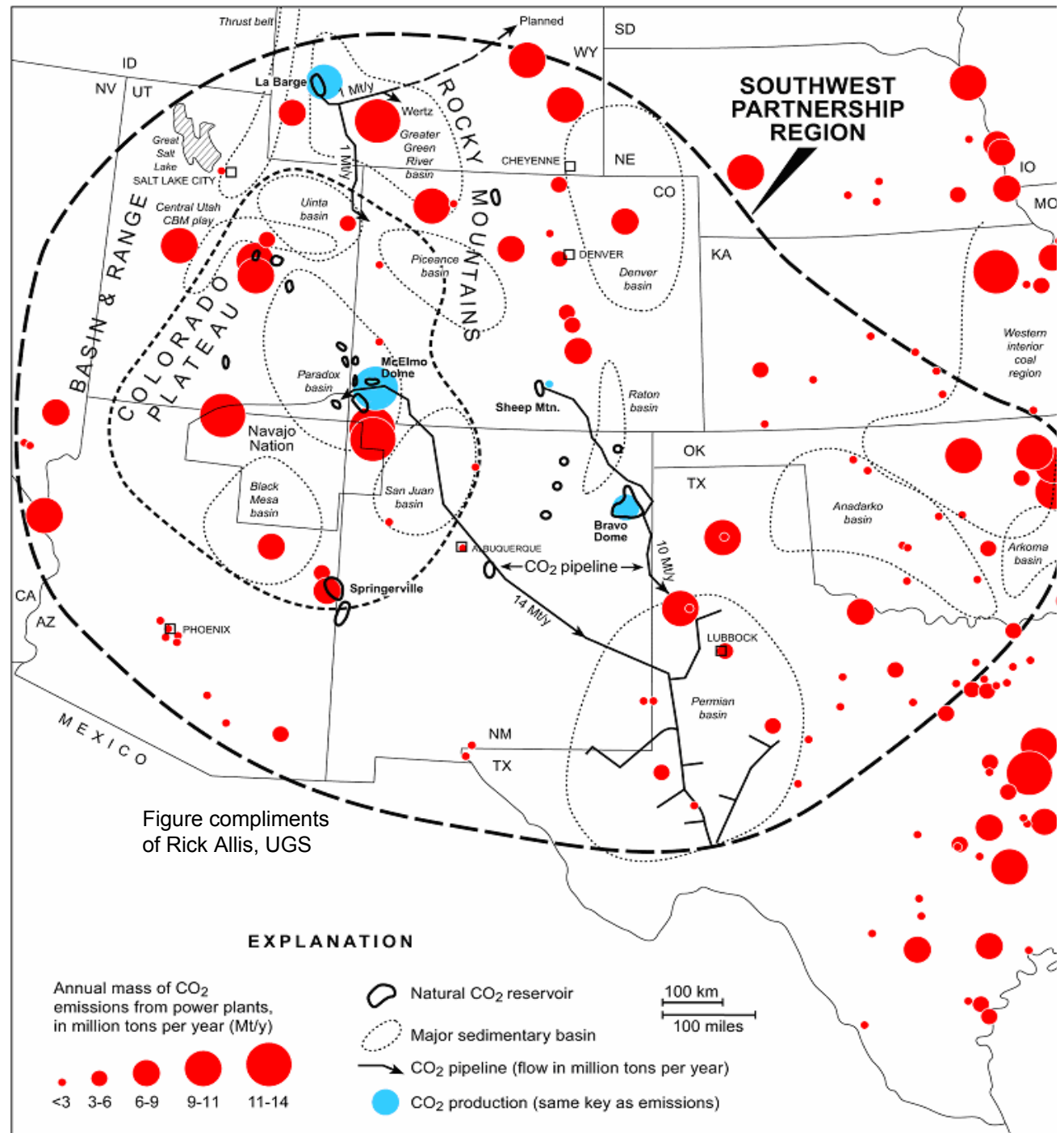
as well as

- Western Governors Association
- five major utilities
- seven energy companies
- three federal agencies
- the Navajo Nation
- many other critical partners

Southwest Sources

- electrical power plants
- cement & other plants
- urban centers
- non-point sources

Total regional point source emissions
 $\sim 10^8$ t/yr.



Southwest Major Sinks

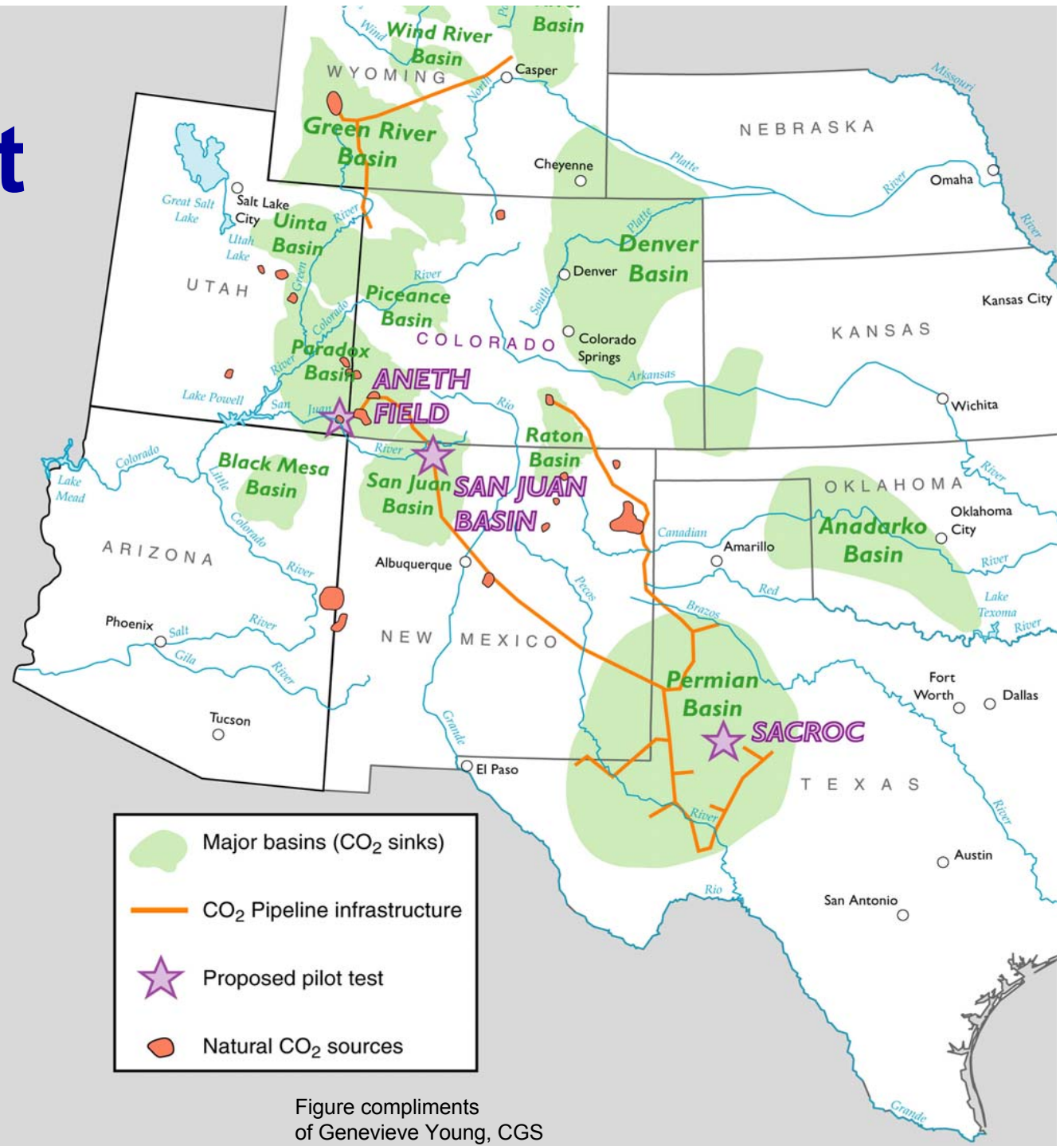
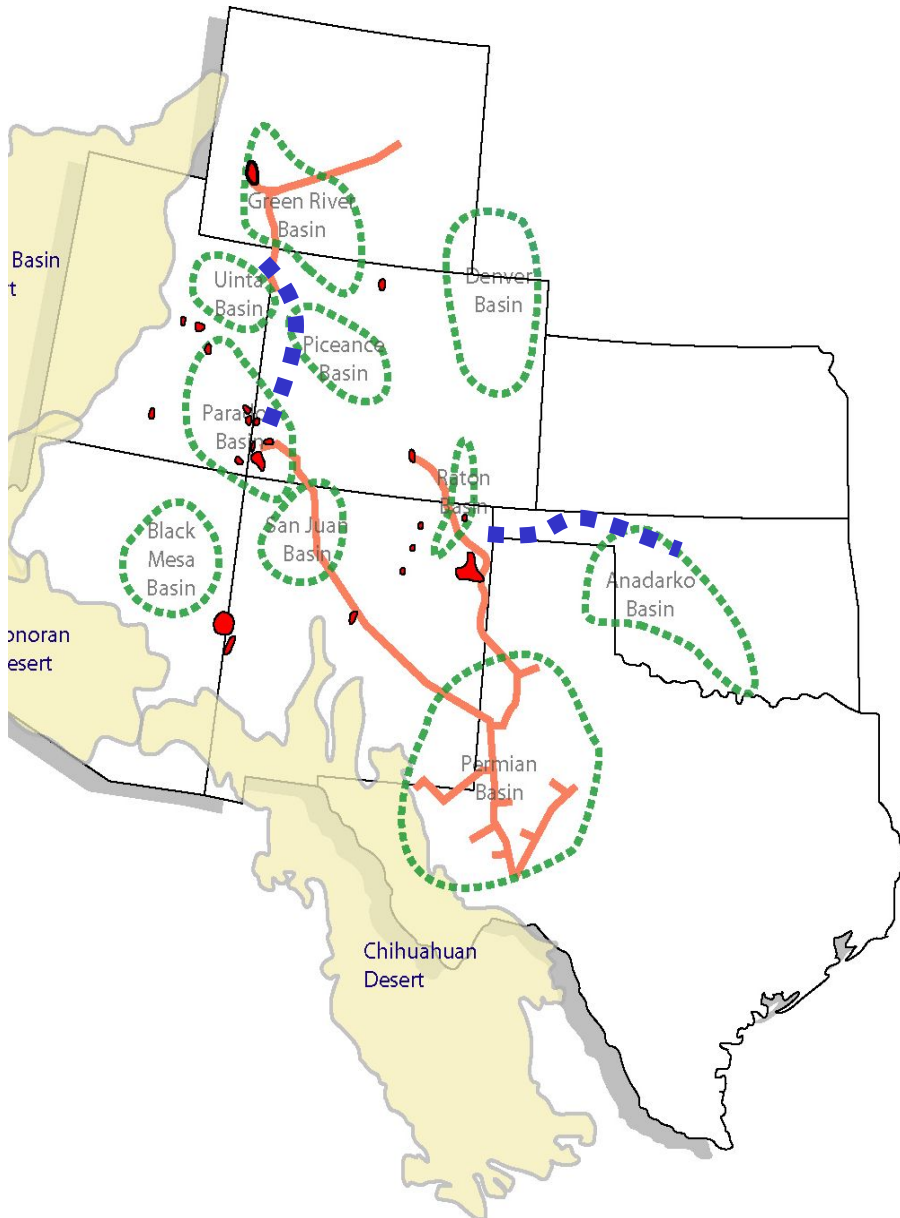


Figure compliments
of Genevieve Young, CGS

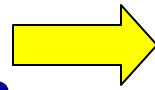
Phase I Task: Link Sources to Sinks



Phase I Primary Tasks:

- Characterize region's sources and sinks
- Identify best options by tying sources to sinks
- Outcome: In Southwest, "first opportunities" lie along existing CO₂ pipelines

**Regional
Characterization**



**Pilot
Demos**

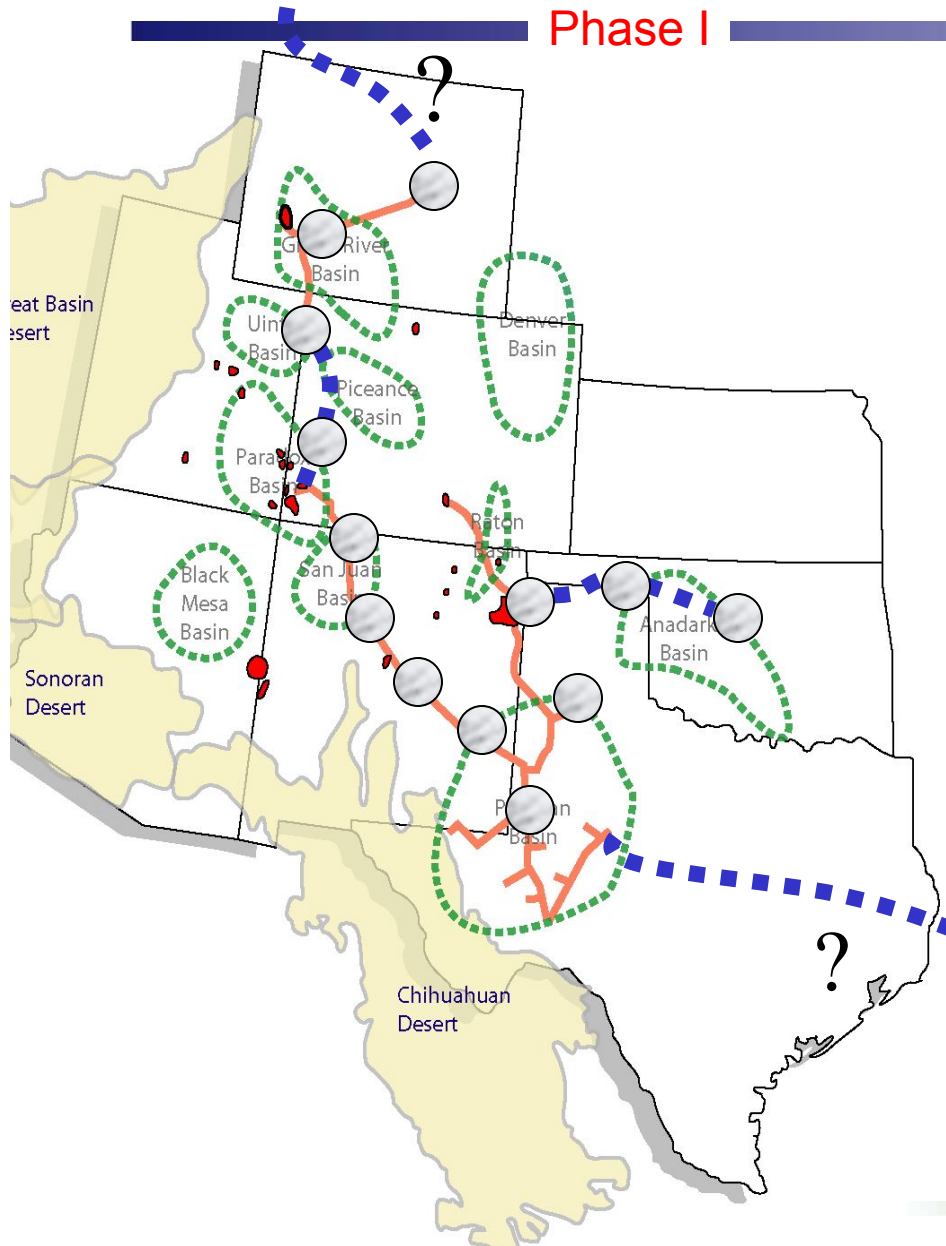


**Full-Scale
Deployment**

Phase I

Phase II

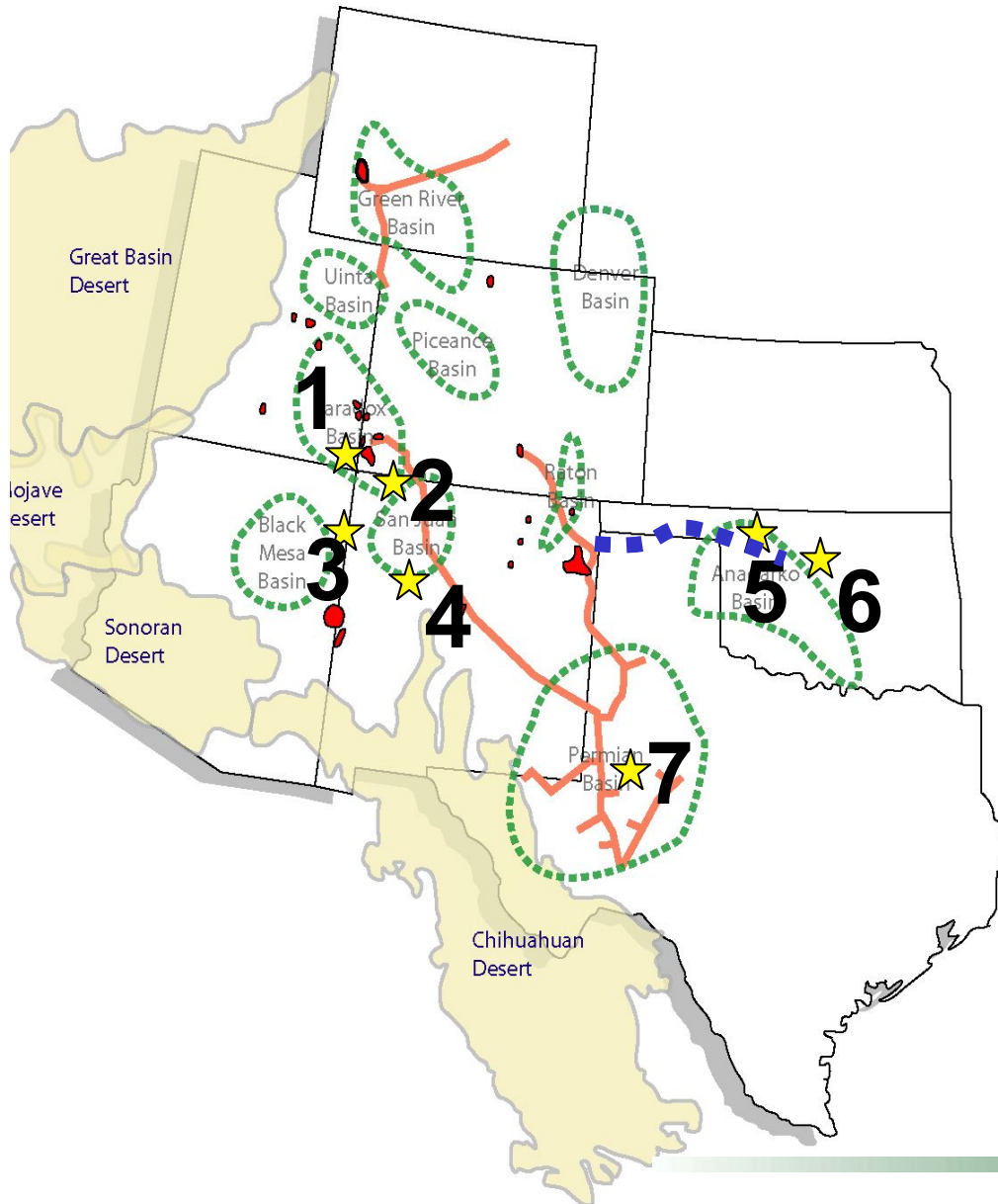
Beyond Phase II



Concept:
“String of Pearls”

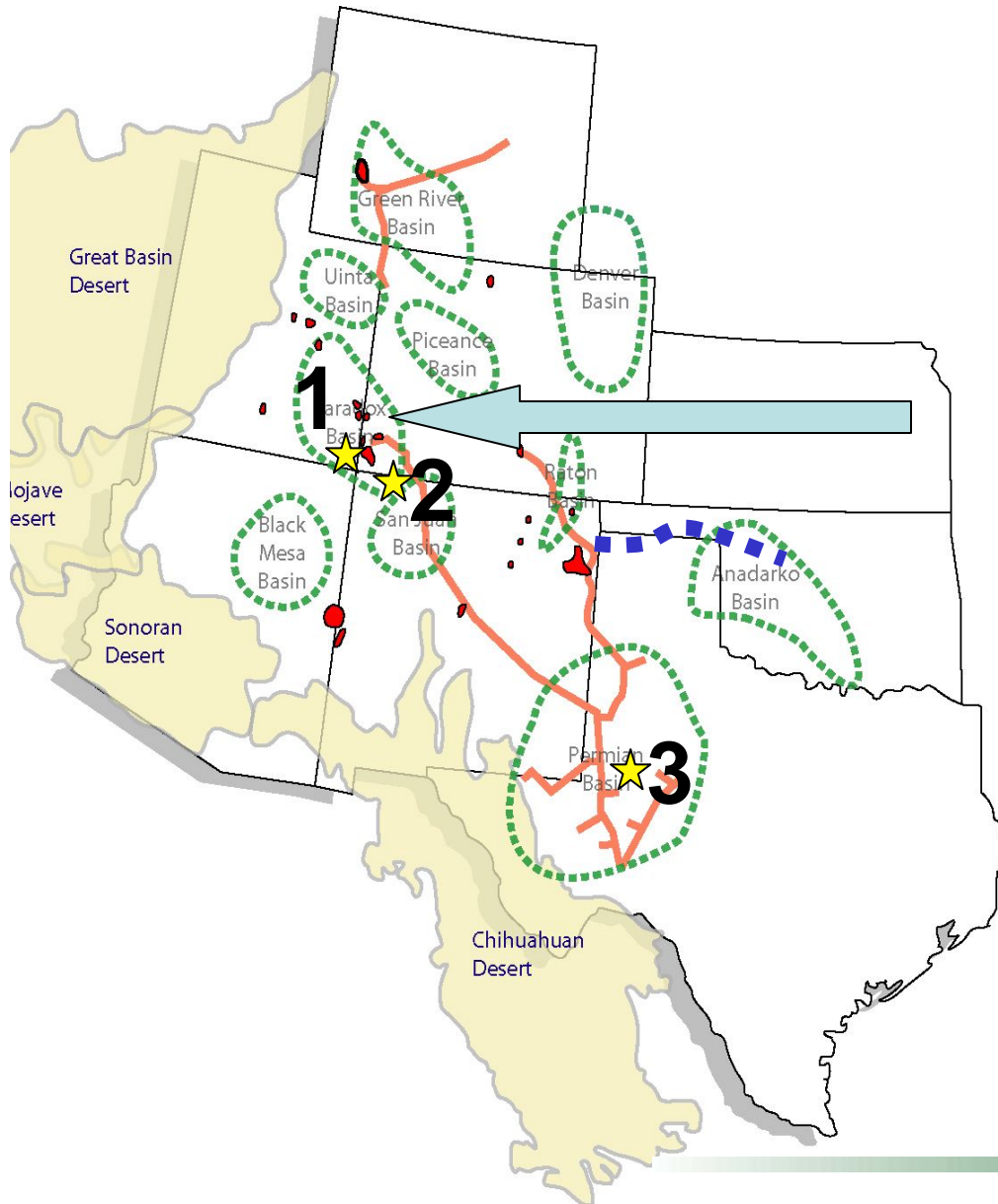
Phase II tests
demonstrate
short-term strategy:
***sequester along
pipelines***

Phase II Test Options



- Over 80 sites considered
- Seven sites made “short list” of top geologic opportunities
- evaluated by many criteria
- some criteria include
 - storage capacity
 - diversity of geologic attributes
 - CO₂ availability for testing purposes

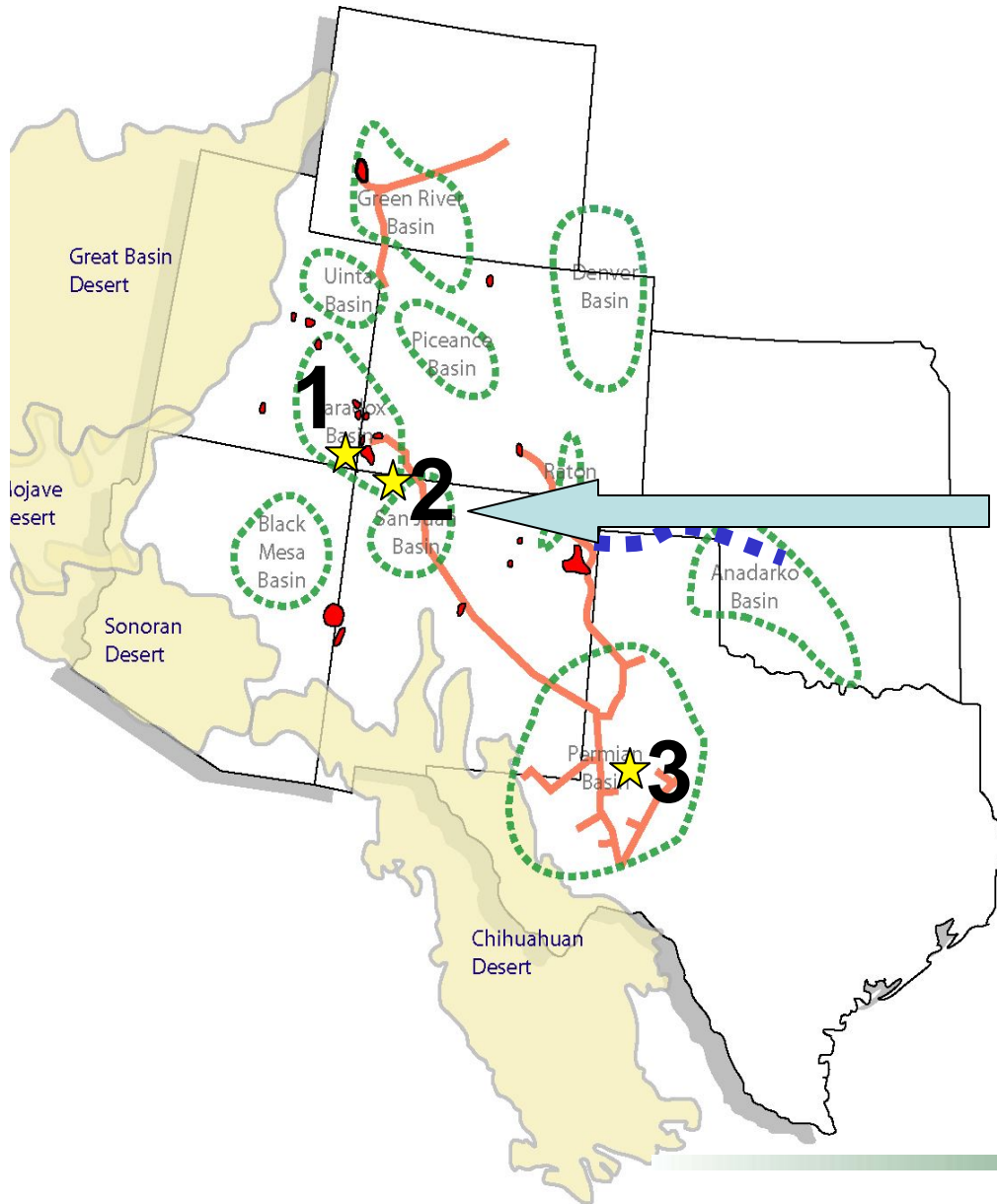
Best Test Options



Three geologic options were selected as the most promising for evaluation in Phase II:

- **combined EOR and deep saline sequestration testing, Paradox Basin, Utah**

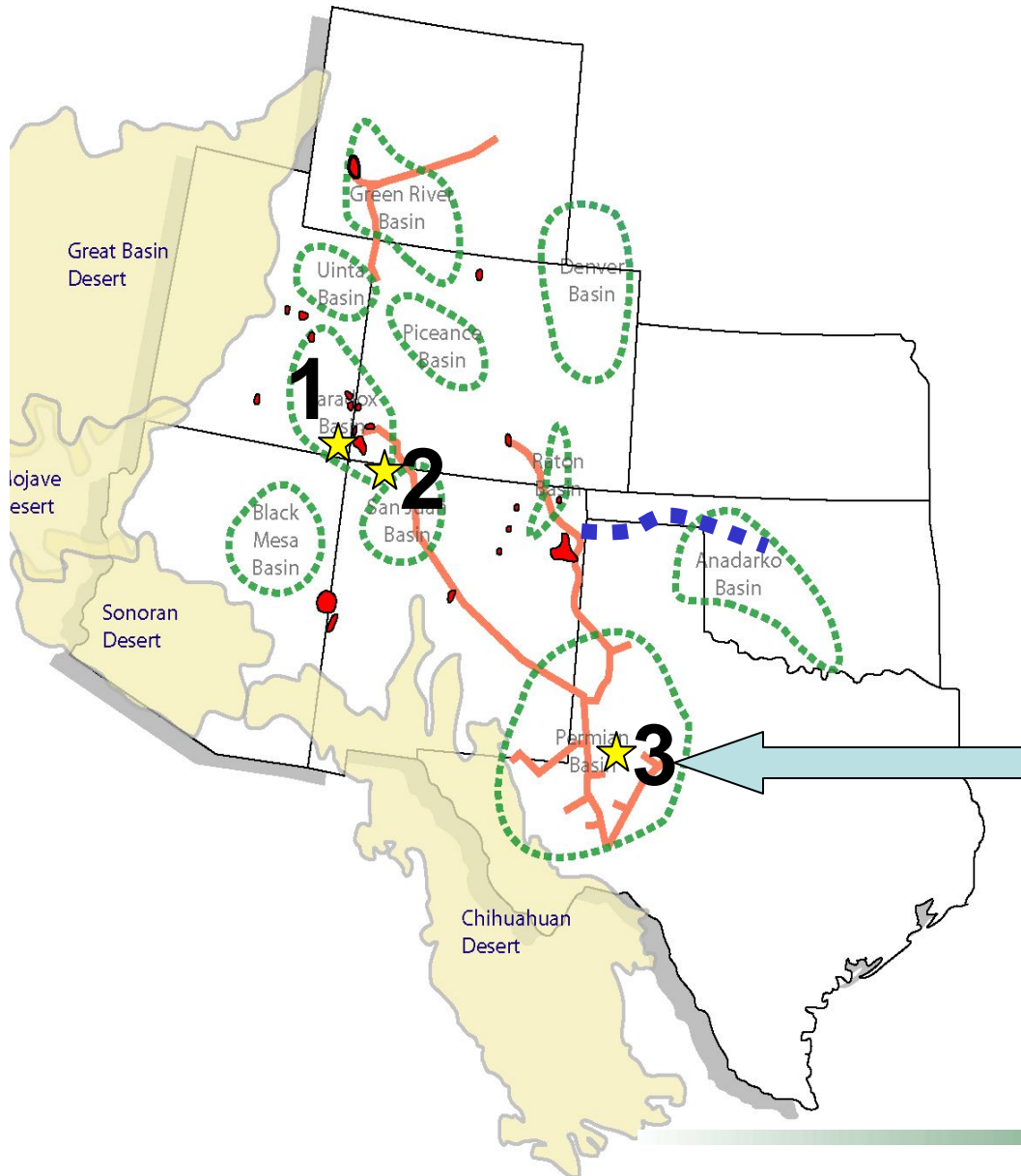
Best Test Options



Three geologic options were selected as the most promising for evaluation in Phase II:

- combined ECBM and sequestration testing, San Juan Basin, NM

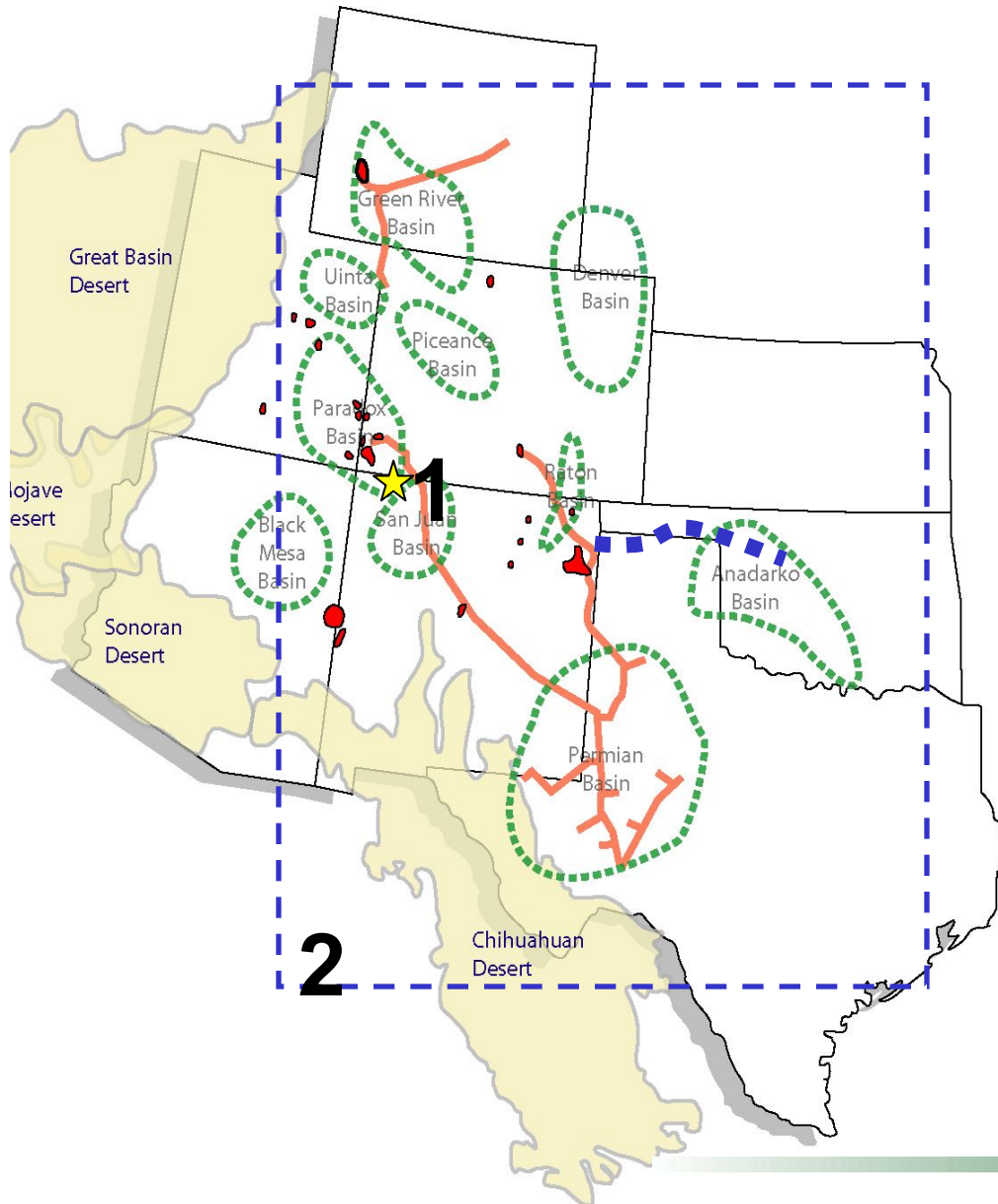
Best Test Options



Three geologic options were selected as the most promising for evaluation in Phase II:

- combined EOR and sequestration testing, Permian Basin, TX

Best Test Options

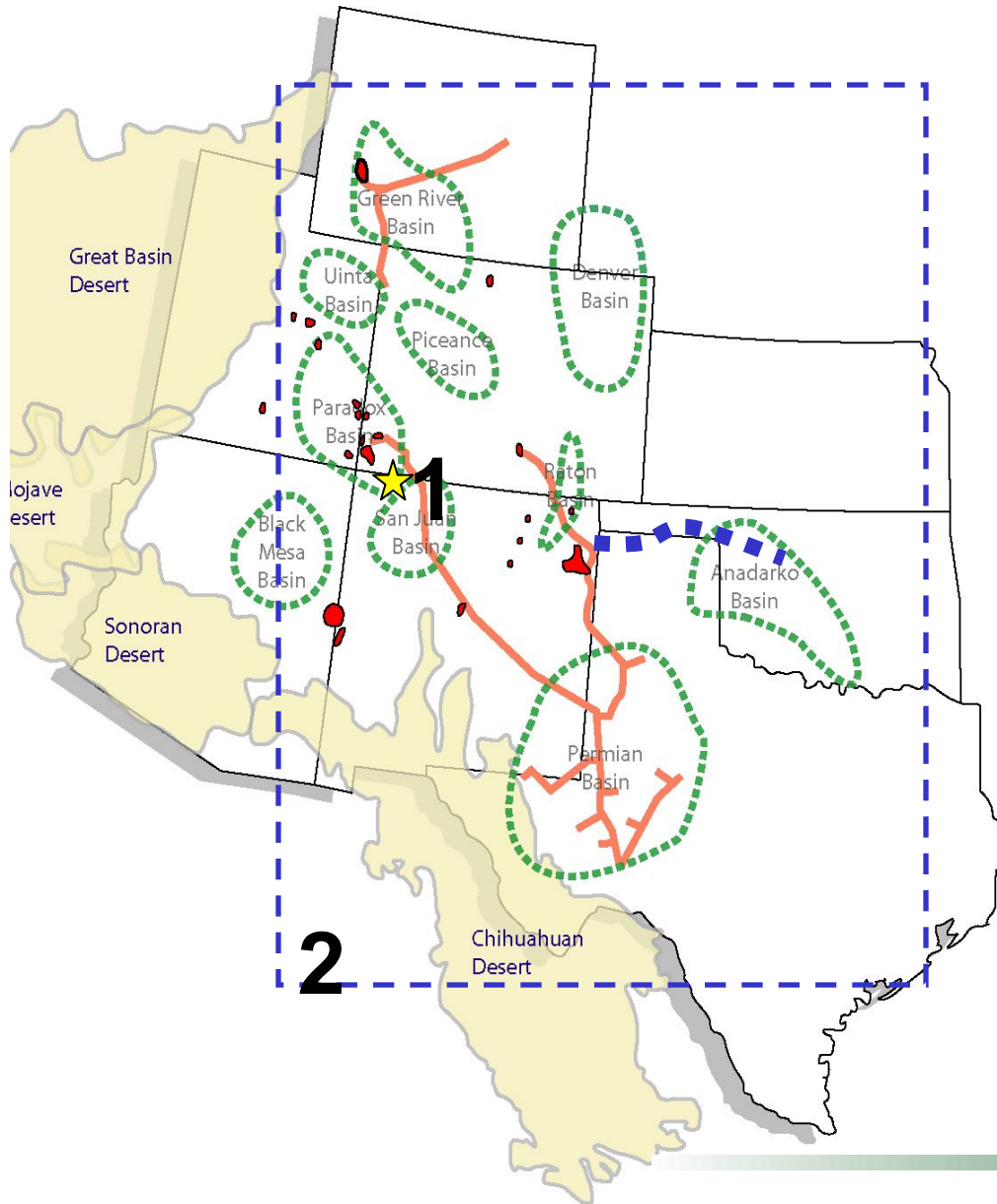


TERRESTRIAL

Two options are being tested in Phase II:

- (1) ~10 km scale terrestrial pilot test in San Juan Basin, NM
- (2) ~100 km scale terrestrial sequestration analysis

Best Test Options



TERRESTRIAL

The ~10 km scale pilot in New Mexico will be conducted in tandem with the ECBM-sequestration pilot: produced water from the ECBM test will be desalinated and used to restore riparian lands.

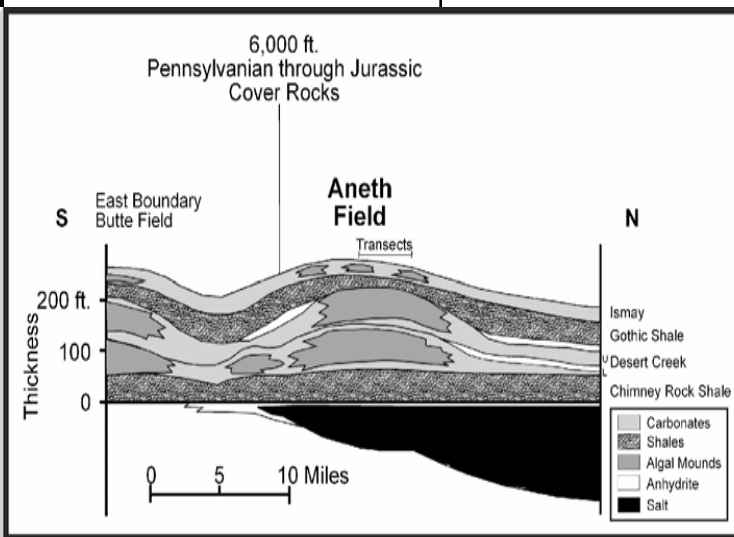
Utah: Two Geologic Tests

- Deep saline reservoir demonstration
 - small-scale injection (5000 to 25000 tons)
 - either Mississippian carbonate or Permian sandstone unit
- EOR - sequestration demonstration
 - “tired” reservoir (Desert Creek Fm.)
 - medium-scale injection (150,000 tons/year for 3 years)

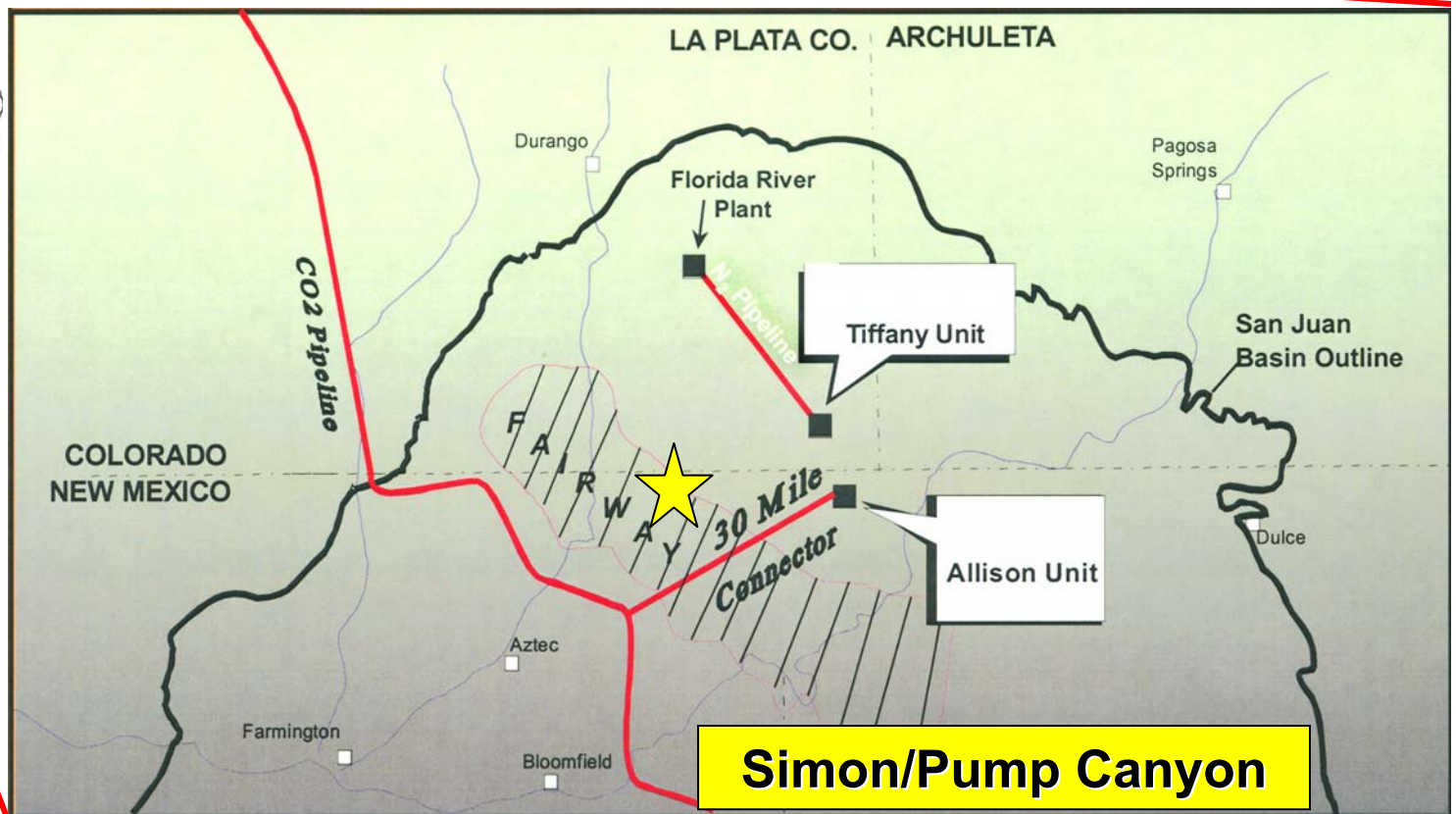


Utah Test Summary

Location	Type of Test	Test Details	Estimated Capacity & Value Added Benefit
Aneth Field, Paradox basin, near Bluff, UT	- Deep Saline - EOR with Sequestration	Up to 150,000 tons CO₂ / year for 3+ years Also: many old and/or plugged- abandoned wells suggest special monitoring needs	- An estimate of minimum capacity of test unit: 100,000,000 tons - Value added Benefit: enhanced oil recovery - Expected increase in oil recovery: minimum additional 15,000 BOPD



The map displays the Permian Basin region, which is highlighted with a red box. The Chihuahuan Desert is shown in yellow. Other basins labeled include Green River Basin, Uinta Basin, Piceance Basin, Paradox Basin, Black Mesa Basin, Denver Basin, and Anadarko Basin. A red line runs diagonally across the map, possibly indicating a geological boundary or a specific geological feature.

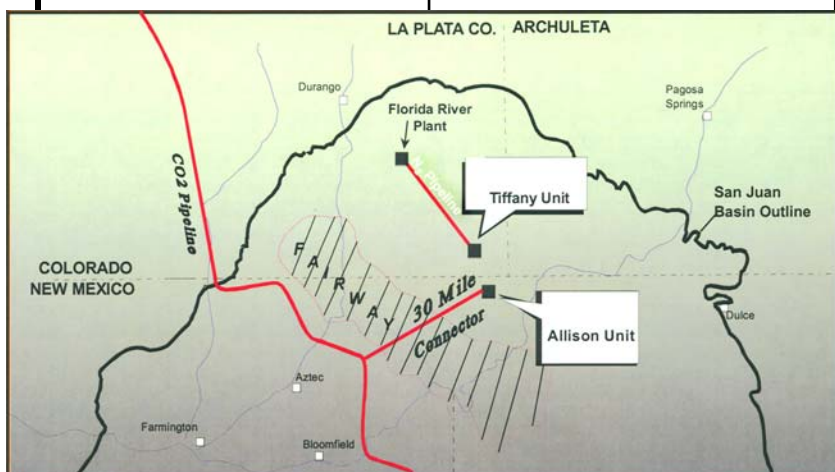


Combined ECBM - Terrestrial Sequestration

- **Two-pronged strategy: enhance existing woody plant species along riparian areas and re-establish native grasses and shrubs in upland areas**
- **Limiting factor: water, both quality and quantity**
- **Desalinate CBM/ECBM produced water using zeolite RO membrane (or other technology) for application to rangeland riparian ecosystems**
- **SWP collaborating with Big Sky Partnership on economic modeling and analysis**

New Mexico Test Summary

Location	Type of Test	Test Details	Estimated Capacity & Value Added Benefit
San Juan basin Coal Fairway, near Navajo City, NM	Combined ECBM testing and terrestrial sequestration evaluation	<p>Geologic: Est. 75,000 tons CO₂ per year for 1 year</p> <p>Terrestrial: Desalinate water from ECBM test and use for riparian restoration</p>	<p>- An estimate of minimum capacity of test unit: 100,000,000 tons</p> <p>- Value added Benefit: enhanced methane recovery</p> <p>- Value added Benefit: wetland restoration</p>

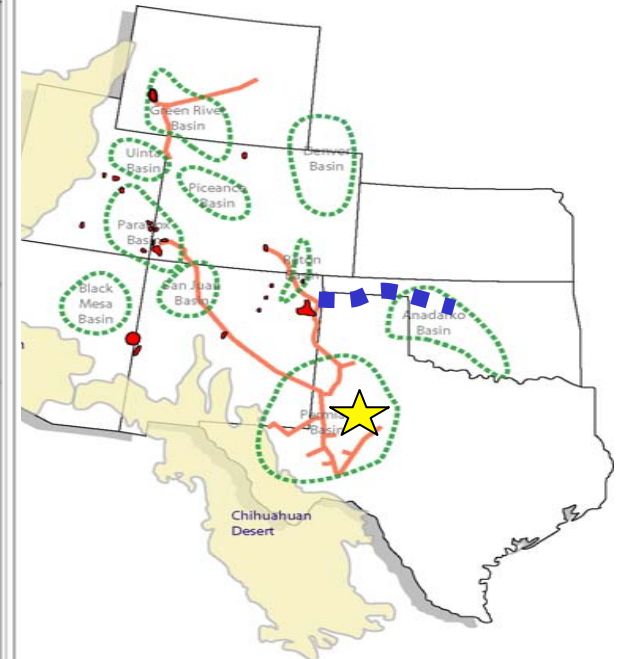
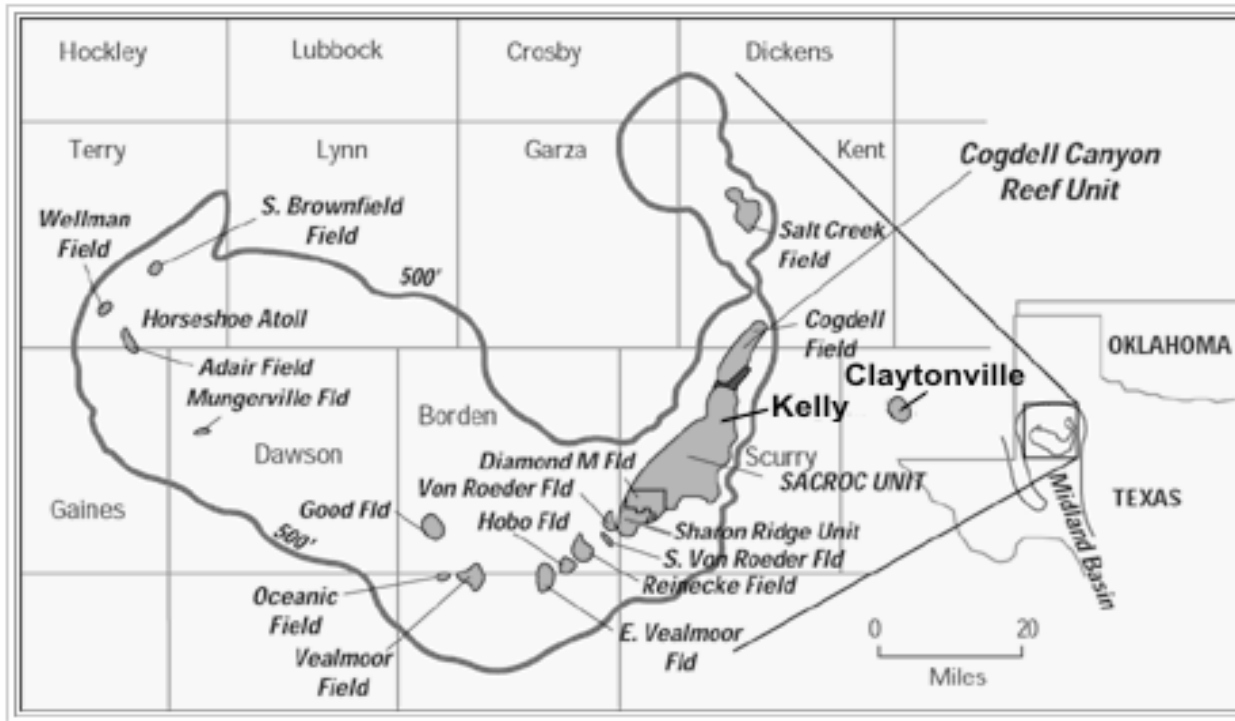


Texas Geologic Sequestration Tests

Two-Tiered Project:

- (1) Detailed Analysis of SACROC field, site of 30 yrs of CO₂ injection for EOR: what happened to CO₂ at SACROC?**
 - Current operations inject ~13.5 Mt CO₂/yr and withdraw and reuse ~7 Mt CO₂/yr = net storage of ~6.5 Mt CO₂/yr
 - the site has accumulated ~ 55 Mt CO₂
 - in comparison, Sleipner injects ~1 MtCO₂/yr since 1996
 - history-matching analysis valuable for future EOR-sequestration
- (2) New CO₂ injection for EOR and sequestration analysis at the nearby Claytonville field, never subjected to CO₂ injection**
 - geology very similar to that of SACROC
 - planned injection of ~150,000 tons per year for life of project`

Claytonville, TX: EOR and Sequestration Demo

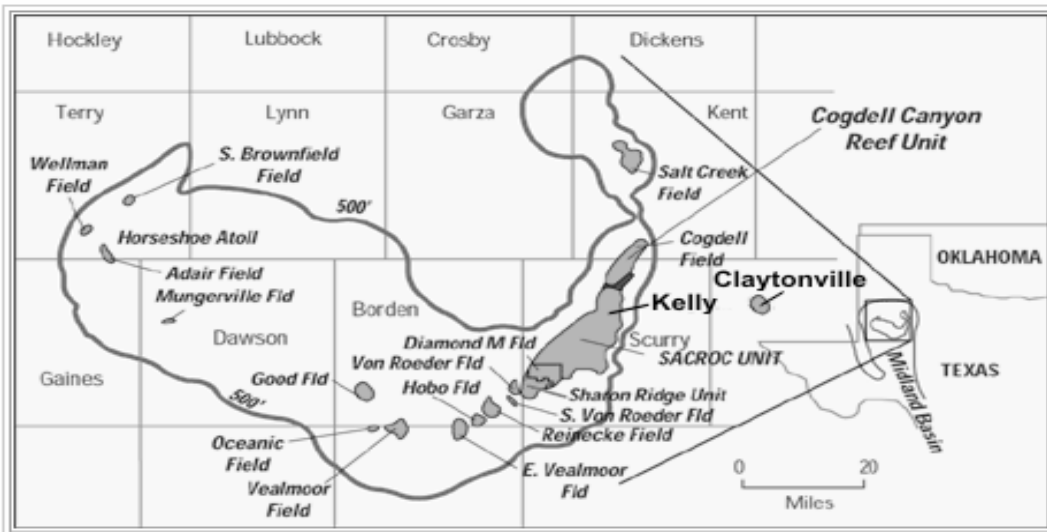


Broader implication: regional geology “Horseshoe Atoll”

- most of western half of atoll reservoirs are below oil-water contact
- represents a potentially huge CO₂ storage site

Texas Test Summary

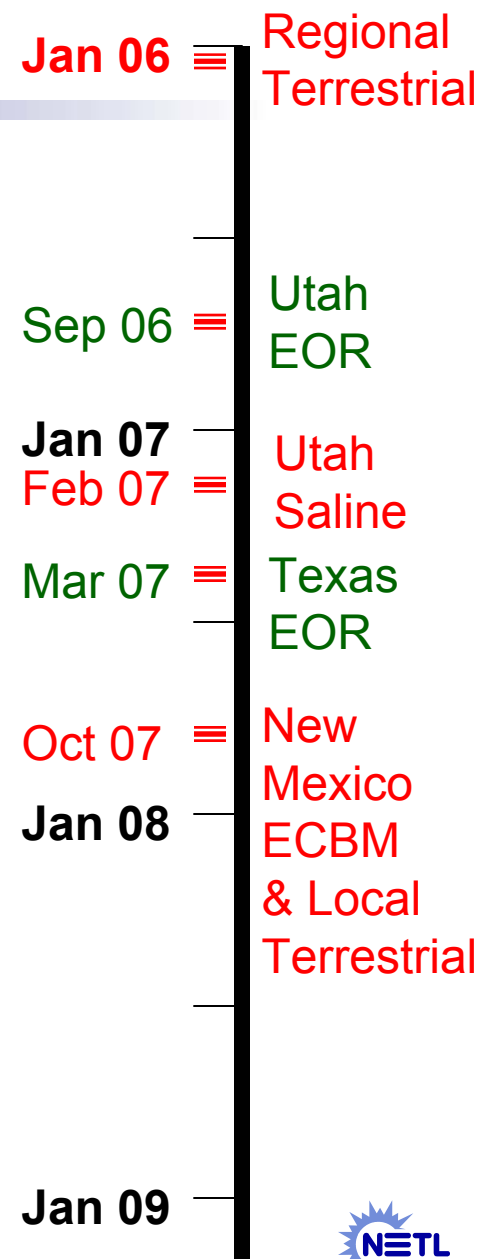
Location	Type of Test	Test Details	Capacity & Value Added Benefits
SACROC- Claytonville Fields, Permian basin, TX	Combined EOR with Sequestration	Over 160,000 tons CO₂ per year for 2 years	<ul style="list-style-type: none"> - An estimate of minimum capacity of test unit: 100,000,000 tons - Value added Benefit: enhanced oil recovery -- Estimated additional oil recovery: unknown (reservoir modeling underway)



Major Objectives

- Test short-term CCS strategies and develop long-term strategies
- Test and maximize efficacy of monitoring technologies (MMV)
- Minimize risks of CCS
- Minimize costs of CCS

Test Schedule



Schedule of Major Activities

Test/Activity	Location	Start Date
Detailed Project Plan	Each Site	Begun
Permitting Process	All sites	Begun
Tailored MMV Design	All sites	Begun
Baseline Models*	All sites	Begun
Risk Assessment	All sites	Begun
Terrestrial - Regional	Region	January, 2006
Baseline MMV	Paradox Basin, UT	January, 2006
Baseline 3-D Seismic	Permian Basin, TX	January, 2006
Baseline 3-D Seismic	Paradox Basin, UT	August, 2006
New Core Acquisition/Analysis	Claytonville Site	NOW
Deep Saline	Paradox basin, UT	Feb, 2007
EOR/Sequestration	Paradox basin, UT	Sept., 2006
EOR/Sequestration	Permian basin, TX	March, 2007
Terrestrial - Riparian	San Juan basin, NM	June, 2007
ECBM/Sequestration	San Juan basin, NM	Oct., 2007

Test Schedule

Jan 06 ≡ Regional Terrestrial
 —
 Sep 06 ≡ Utah EOR
 —
Jan 07 —
Feb 07 ≡ Utah Saline
 —
 Mar 07 ≡ Texas EOR
 —
 Oct 07 ≡ New Mexico
 —
Jan 08 —
 ECBM & Local Terrestrial
 —
 Jan 09 —

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